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Savings and investment fiscal policies: A quantitative analysis for the Italian economy

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**Wirtschaftswissenschaftliche Fakultät
der Eberhard-Karls-Universität Tübingen**

**Savings and Investment Fiscal Policies:
A Quantitative Analysis for the
Italian Economy**

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**Savings and Investment Fiscal Policies:
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Anna Ruocco

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Abstract

This paper is mainly concerned with the real effects of different kinds of savings/investment incentives on the capital accumulation. Investment incentive programmes, at least in Italy, have been part of the standard government budget for a long time. Therefore, especially from a policy-maker point of view, it is interesting to find out which are the quantitative impacts of these programmes.

In particular the focus has been concentrated on: a) sector specific incentives to capital services; b) fiscal deductions on the income tax base and subsidies to purchasers of assets which qualify for the programme. These incentives schemes have been analysed performing numerical simulation of equal-yield tax changes within a general equilibrium growth model for Italy with overlapping generations. An intertemporal model has been used since the political discussion encompassing policy initiatives, such as the investment programmes, revolves around the steady-state effects rather than the static ones.

Introduction

In Italy, as well as in Europe generally, the economy in the last decades has been characterised by the decline of the traditionally important sectors and by an exceptionally low investment rate¹.

The decline in the investment rate affected the rate of growth of the economy and the level of unemployment. Therefore the Government adopted different types of investment incentive to encourage capital formation and consequently to diminish the level of unemployment.

In Italy, investment has been promoted through ample depreciation allowances and a variety of exemptions that cut down the effective corporate tax rate².

The purpose of this paper is to give an evaluation of the potential of different kinds of investment incentives in promoting the capital accumulation process.

Due to the nature of the variables being examined - investment incentives - this analysis can only be developed using an intertemporal applied model.

Intertemporal applied models can be classified into two main categories:

- i) the recursive models, which maintain the disaggregation of the standard static models but are generally based upon myopic or adaptive expectations. It is well known that these two approaches introduce systematic errors in the agent's predictions. In this sense, in simulation, one cannot distinguish between the effects due to the prediction errors and the ones due to the policy change;
- ii) the fully dynamic models, which are based upon the perfect foresight hypothesis and describe the transition path to the new equilibrium point. Since these models require a great computational effort, they usually represent just one productive sector.

However, the need to work with a disaggregated economy becomes evident when we treat the intersectoral incentives. In fact, the rules to be entitled to obtain the subsidy could differ from one sector to another, so that the effective tax abatement is not uniform in the economy. At the same time it seems preferable to use the perfect foresight approach. To this end, we developed a single-country, multi-sector general equilibrium model with overlapping generations applied to the Italian economy. More specifically, in this work a steady-state model has been connected with a static one. So it becomes possible to extend a relatively rich, detailed static structure to meet the long-run upper bound welfare effects of the policy under investigation. Consequently,

1. Ginsburgh and Sneessens (1989).

2. Franco, Gokhale, Guiso, Kotlikoff and Sartor (1994).

the endogenous growth of capital stock is represented in a multi-sector framework with perfect foresight expectations.

The results of policy simulations represent the long-run equilibrium of the economy submitted to an external shock and match the equilibrium solution of a fully dynamic model. Unlike the latter ones, the steady-state model does not consider the transition path to the new equilibrium. As far as welfare results are concerned, this implies that the effects on the generations living in the transition period are not considered. To minimize the intergenerational redistribution we impose an annual budget constraint on the Government, so that it can finance its present consumption with future tax revenue.

The plan of the paper is as follows: section 1 discusses the main problems dealing with the time variable. In particular it illustrates how the equilibrium itself and the solution method might be sensitive to the expectations; section 2 presents the main features of the numerical model, which is applied to the Italian economy, with 1982 as its benchmark period³; section 3 covers some basic theory concerning the effects of specific subsidies in a neoclassical structure; section 4 illustrates the main theoretical implications of indirect and direct investment incentives; in section 5 we simulate the subsidy schemes described in the two previous sections to illustrate their empirical effects. The concluding remarks are included in the last section.

1. Recursive and fully dynamic applied models.

Applied general equilibrium models that reflect real economies have become a standard methodological tool for the analysis of fiscal policies. That is because by formally structuring an economic system, it is possible to simulate and investigate the effect of changes on the system. The construction of the model itself does not represent the aim of the research, so the validity of the model should be judged with respect to its ability to give credible answers to the question at issue. In other words, a model cannot be judged better or worse than another in absolute terms. In fact, generally, models are designed to study a particular set of fiscal policies, therefore they can appear no suitable tools of analysis for other interesting questions.

Since our aim is to give an evaluation of sector-specific capital subsidies with at the same time a variable capital supply, it is obvious that the time variable becomes a central ones.

To introduce the time into a micro-founded applied model, we should cope with different problems. First, economic agents plan their choices on certain expectations, which have to be defined. Secondly, the lifetime horizon of the economic agents has to be specified. Finally, one has to design a specific investment function.

3. The data base was previously used in the ITALIA/GE model. See Fossati (1991).

Of course, there is a variety of possible answers to the above mentioned problems. Depending on the choices made, models will rely on different notions of equilibrium and will possess distinct normative capabilities.

Economic planning in the long-run requires information about the future value of endogenous economic variables, whose realisation depends on the actual as well as on the future state of the economy. A possible method to capture all these effects would be to consider a complete set of contingent markets where the delivery date of all commodities is negotiated at the initial period for all the future dates and states of the world. However this approach is unrealistic, and in computable models future markets are substituted by an expectation concept. The use of expectation allows us to consider each agent's perception of the future, which can be different according to the agent's capability to foresee.

A first notion of foresight refers to the so called rational expectations hypothesis: economic agents do not make systematic errors in predicting the future. That is, agents are said to be rational: because their prediction about the future coincides with the real evolution of the economy. Under this aspect, there is no real distinction between the hypothesis of rational expectations with perfect foresight and the existence of a complete set of contingent markets. It must be noted that, anyway, the notion of uncertainty involved in both cases is the so called *exogenous uncertainty*⁴. It is also worth noting that the strengths of the rational expectations approach lays in the other approaches' weakness. If we exclude the rational expectations hypothesis, in fact, by definition we must assume that individual conjectures are somehow systematically incorrect. Of course, results can be highly sensitive to the hypothesis about individual conjectures⁵ given that individuals' expectations about the effects of a policy change would turn out to alter the actual results obtained in simulation⁶.

As far as applied models are concerned, they have mainly been based on the two extreme hypotheses: myopic expectations, on one side, and perfect foresight (rational expectations), on the other side. It must be stressed that the choice between myopic and rational (perfect) expectations turns out to imply a different solution method of the model, therefore a different algorithm has to be chosen.

In the case that the future prices are not correctly foreseen, we will obtain a sequence of temporary equilibria. In particular, if we assume the myopic expectations hypothesis, the consumers will think that future prices remain fixed at the current

4. In the real world the behavioral uncertainty, that means the uncertainty related to the behaviour of economic agents, it is the more tricky one. If we want to take into account the interdependency of the agents behaviour, maybe a Nash equilibrium model would be considered the more appropriate approach. See Perroni and Whalley (1993).

5. Pereira (1988).

6. See Lucas (1967); Ballard and Goulder (1985).

level. The implied assumption is that the individuals completely ignore the effects produced on the economy by the policy performed. The temporary equilibria are linked to each other by the capital accumulation process, which is endogenously determined by the savings decision. The problem in using this hypothesis is that one cannot distinguish between the effects on welfare deriving from the erroneous conjectures and those strictly due to the policy at issue.

As we have already said, within the scheme of myopic expectations the economic agents do not consider any information about the future value of the relevant variables so that the model can be solved recursively. An example of a recursive model is shown in Ballard, Fullerton, Shoven and Whalley (1985)⁷.

If the future prices are correctly foreseen, we will obtain a perfect foresight equilibrium solution. Current decisions rely on the future path of prices and the current equilibrium is affected by the past as well as by the future equilibria. The future choices are just the fulfilment of the decisions taken in the current period. This kind of model is defined as fully dynamic since the equations of the current and future periods have to be simultaneously solved. This implies the possibility to track the path of the economy back from the initial steady state position to the new ones, after an external shock has taken place. In this sense this type of model considers the adjustment processes that the economy passes through in reaching the new stationary equilibrium. From a computational point of view, this approach is extremely demanding, so generally the represented economy is highly stylized, to the point of including only a single productive sector. Computable general equilibrium models which first adopted this approach include Bovemberg (1985) and Auerbach and Kotlikoff (1987).

In this light, we can say that the model presented here is a compromise solution in that it is a steady-state model: it does not represent the transition path, but it designs a disaggregated economy with perfect foresight and overlapping generations.

1.1 Agents' lifetime horizon.

Beside the choice of the expectation, one has to establish the agent's lifetime horizon. All the micro-founded dynamic models include the life-cycle hypothesis to some extent. In the traditional neoclassical model there are two ways to design the lifetime horizon of economic agents: (i) consumers maximize over an infinite lifetime horizon; (ii) there is an infinite number of consumers with a finite lifetime horizon (overlapping generations). Within the pure life-cycle model, consumers maximise their intertemporal utility function subject to a lifetime budget constraint (the discounted value of income equals the discounted value of expenses); which means that their

7. See also Bovemberg and Keller (1981).

present demand is not strictly dependent on the present income but rather on the stream of future income. Generally the utility function is assumed to be additively separable over time and defined over the set of produced goods (sometimes also the choice between consumption and leisure is considered). The savings choice of consumers is modelled by the capital accumulation process, hence it is possible to isolate which factors determine the capital accumulation and which ones affect the welfare of other generations.

While the infinitely living agent is a convenient approach in that it allows many simplifications, it can be considered too unrealistic. In this sense the overlapping generation approach seems to be a more appropriate theoretical framework, especially when redistributive questions are at issue. But, in the light of the model that we present in this paper, we should underline some important aspects. First, as far as the normative attributes of overlapping generation models are concerned, the equilibrium solution of the competitive economy does not necessarily match the equilibrium of a centralized economy. In fact, problems can arise in defining the relevant social welfare functions. If the agents live indefinitely we can assume that the social welfare function coincides with the individual utility function. If different generations coexist in a certain period we face the same problem relating to the welfare function in an economy with several groups of consumers, differentiated by income⁸. In addition, in the overlapping generation models the choice of the tax base is also a choice of the taxpayers. Let us think about a simple two-period model in which the young individual works, consumes and saves while the old one just consumes. Then a tax on the labour income will be borne by the young while a tax on the consumption for the old will be a lump-sum, since he cannot change his choice.

2. The model

We designed a single-country, multi-sector general equilibrium model with overlapping generations and constant returns-to-scale, applied to the Italian economy, with 1982 as its benchmark year. More specifically, it is a neoclassical growth model for a closed economy with no technical progress, therefore the accumulation of physical capital is the only endogenous source of growth. It provides intertemporal variations of the welfare gains and of the capital accumulation that may be expected to result from the change in the fiscal policies concerning the investment and savings incentive programmes.

8. For example Samuelson (1968), in order to solve this problem, considered a centralised economy where the central planner maximises the actual value of the present and future utilities by an appropriate discount factor. Clearly, the choice of the discount factor will reflect the importance given by the Government to the different generation.

The peculiarity of the model is that the steady state framework has been connected with the static one, so that finally it becomes possible to show how a relatively rich, detailed static model can be extended to meet the long-run upper bound welfare effects of the policy under investigation.

Since the model can be disaggregated in n production sectors, it is possible to study the effects of policy on specific markets. The major weakness of the model is the steady-state framework itself: in reading the results obtained in simulations we should be aware that, even if they reflect the long-run position of the economy, they can be misleading because they do not take into account the intergenerational redistribution of different fiscal policies. The only way to consider this kind of redistribution is to examine the dynamic transition path which drives the economy from the initial steady-state position to the final one. A way to overcome this problem is to introduce a transfer function into the steady-state model, which moderates the effects of the implicit redistributions among generations. We achieved this objective by imposing a Government budget constraint over each single period (and not in terms of discounted value of income and expenditure).

The consumer side has been modelled using the overlapping generations approach, which seems to be a fair way to represent the consumption and saving decision. On the production side, firms maximise their profits in a competitive market. There are no adjustment costs, which does not always seem to be an innocuous assumption to impose⁹. Since it is a closed economy, the external repercussions of fiscal policies are not considered. For example, in an open economy, the increased demand for resources generated by a subsidy to the use of the capital factor can be supplied from the rest of the world.

Finally, neither money nor (voluntary) unemployment have been explicitly represented, whose existence is linked to a certain degree of uncertainty about the future and creates infeasible computational problems.

2.1 The Consumer side.

Following Auerbach and Kotlikoff (1987) each household is represented by an adult who chooses an optimal path of consumption over his lifetime, given his preferences and his lifetime budget constraint. Since the representative individual makes lifetime decisions about consumption and he also leaves bequest and receives inheritance, the model departs from the pure life-cycle model.

The population is divided into age groups (or cohorts) of an equal age span, which is one year. Since every member lives for 55 years and supposing that people die at the age of 75, the first group consists of all those members of the population between the

9. See Auerbach and Kotlikoff (1987).

age of 21 and 22 years old, the second consists of those between 22 and 23 years, and so on. Every year a generation dies and another one is borne. We made the implicit assumption that preferences are fixed: different individuals share a common system of preferences that do not change over time¹⁰. Variations in behaviour among individuals are explained exclusively by differences in economic opportunities. By assumption, the aggregate behaviour of members of a generation is described by the behaviour of a single member. Therefore, different generations will have the same demand multiplied by the factor of population growth. The latter is fixed at some constant annual rate, denoted by n . The functioning of this economy has been summarised in table 1: in period $t(1)$ there is just one generation alive, in period $t(2)$ two generations coexist and so on. The period $t(55)$, in which the first full overlap takes place, represents the benchmark equilibrium.

TABLE 1

	$t(1)$	$t(2)$...	$t(55)$
1st generation	$D_{1,1}(1)$	$D_{1,2}(2)$		$D_{1,55}(55)$
2nd generation		$D_{1,1}(1)(1+n)$		$D_{1,54}(55)(1+n)$
....				
55th generation				$D_{1,1}(55)(1+n)^{54}$

$D_{1,1}(1)$ is the demand of the representative member of the first generation of the age cohort 1 (which is indicated by the number after the comma) at the time period 1 (which is the number in the brackets). The economy is assumed to be on a balanced growth path, that is the capital endowments grows at the same rate n as the effective labour force, where n is the growth rate of effective units of labour, which reflects population growth. On the steady-state path all relative prices (the numeraire is equal to one) remain constant:

10. We are aware of the fact that, even if common, this is a very strong hypothesis for different reasons. For example, individual tastes are dependent on factors such as demographic and social variables. More than this, people make mistakes in their planning or they depart from their plans randomly and it could be desirable to specify some allowance for this.

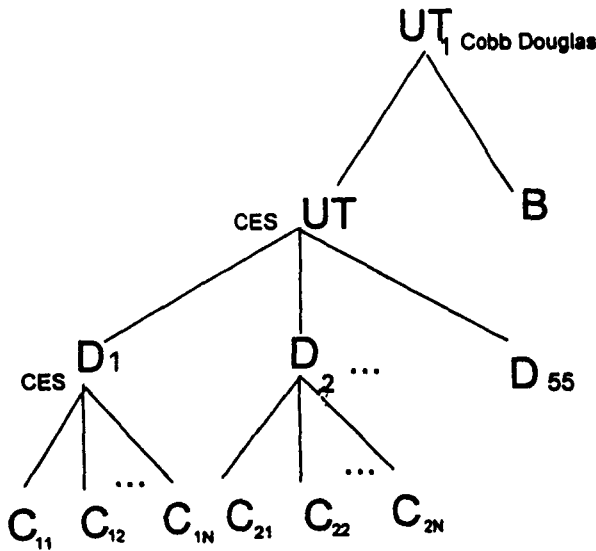
$$p_t = p_{t+1} = \dots = p; w_t = w_{t+1} = \dots = w; r_t = r_{t+1} = \dots = r.$$

Given this hypothesis, in order to calculate the aggregate demand we should only allow for the population growth. As $D_{1,1}$ is the unit demand of the cohort 1, to obtain the demand of the second generation of the same cohort we need to multiply $D_{1,1}(1)$ by $(1+n)$. More clearly:

$$D_{2,1}(2) = D_{1,1}(1) (1+n)$$

For simplicity we can suppress the index of the generation and of the time period, since the only thing that matters is the cohort of the agent. The utility tree of the representative member of each generation is drawn in figure 1.

Figure 1



1st Step. At the top level the consumer maximises a utility function of the Cobb-Douglas type defined over the total consumption of his life and the bequest to leave:

$$UT_1 = UT^{(1-\beta)} B^\beta$$

subject to the budget constraint, in which the consumer income (M) is given by:

$$M = \sum_{t=1}^{55} LW_t(1-T) + B \frac{P_t}{[1+r(1-T)]^{25}}$$

where T is the personal income tax rate (which is a proportional tax), L is the endowment of labour in each period of his life, P_t is the capital good price, r is the interest rate and W_t is:

$$W_t = \frac{w}{[1+r(1-T)]^{t-1}} \quad t = 1, \dots, 55;$$

B is the inheritances that the consumer receives when he is 46 years old.

So the bequest that the consumer will leave is:

$$B = \beta \frac{M}{P_B}$$

where:

$$P_B = \frac{P_t(1+n)^{29}}{[1+r(1-T)]^{54}}$$

Given that we used a Cobb-Douglas utility function, the bequest will be equal to a certain constant fraction of the present value of income.

2nd Step. At the second nest, a time-separable and of the nested, constant elasticity of substitution (CES) form utility function provides the possibility of substitution between present and future consumption. Thus, changes in the real after-tax interest rate (the relative price of present and future consumption) have an effect on the private savings rate in the long-run. Specifically we used the following function:

$$UT = \left[\sum_{t=1}^{55} \beta_t D_t^{\frac{(\sigma-1)}{\sigma}} \right]^{\frac{\sigma}{(\sigma-1)}}$$

where β_t is the distribution parameter defined as:

$$\beta_t = \frac{1}{(1+\rho)^{(t-1)}}$$

ρ = pure rate of time preference;

σ = intertemporal elasticity of substitution.

In each period, the consumer decides on the amount of his consumption expenditures. The excess of after-tax earnings from labour and capital income is saved and added to the household's stock of assets.

3rd Step. The consumer each year should decide between the set of produced goods. So the intratemporal utility function is given by:

$$CT = \left[\sum_{g=1}^N \beta_{2g} C_g^{\frac{(\gamma-1)}{\gamma}} \right]^{\frac{\gamma}{(\gamma-1)}}$$

where γ is the intratemporal elasticity of substitution within the consumption bundle and β_{2g} are the distribution shares between the different consumption goods. We do not consider the choice between the financial and the real assets because even if the portfolio theories are relatively well established, they all require the introduction of some kind of uncertainty¹¹. In this specification the needs are not weighted depending on the age: we assume that the willingness to consume is the same at every age. The conditional demands for each good deriving from the utility maximization problem are:

$$C_g = CT \left[\frac{\beta_{2g} P_{UT}}{P_g} \right]^{\gamma} \quad g = 1, \dots, N$$

where P_{UT} is:

$$P_{UT} = \left[\sum_{g=1}^N P_g^{(1-\gamma)} \beta_{2g}^{\gamma} \right]^{\frac{1}{1-\gamma}}$$

11. The consumers save by buying capital goods. There are many others way to invest, but we assume that the different financial instruments give the same rate of return, so that they become perfect substitutes. Furthermore, given that in a neoclassical framework is not possible to distinguish between the consumer wealth and the firm's, it cannot be distinguished between the savings of the firms and the ones of the households.

and P_g is the price of good g . Due to the steady-state hypothesis, relative prices remain constant so that individuals do not change their demand over the years

$$C_{1,1} = C_{2,1}; C_{1,2} = C_{2,2} \dots C_{1,N} = C_{2,N}$$

The latter hypothesis combined with the one that different generations belonging to a certain cohort will have the same demand, multiplied by the factor of population growth, makes it possible to write the following constraint:

$$CT = \sum_{t=1}^{55} D_t (1+n)^{(55-t)}$$

In this way we have drastically simplified the number of equations needed to be computed to obtain the solution of the model. In fact, instead of specifying 55 sub-utility functions, each defined on n elements, we specified just one utility function and an additional constraint.

This framework has the disadvantage that it allows a strong intertemporal substitutability between consumption and saving, substitutability that could reach unrealistic levels especially with the presence of fiscal policies such as the savings incentives ones. Alternatively, to diminish the discretionary consumption power one can use utility functions of the L.E.S. type, which guarantees a minimum level of consumption in each period.

2.2 The Production side

We describe an economy in which profit-maximising firms sell their output in a market that necessarily clears instantaneously, in other words we delineate a competitive market. Our specification is fairly general: firms are price takers, produce their output with labour and capital, which are perfectly mobile. The model incorporates the assumption that firms can adjust the amount of labour and capital employed at no cost to a new desired level. This leads to the standard static result that, in equilibrium, w , which is the gross wage in period t , must equal the marginal product of labour and r , the gross interest rate, must equal the marginal product of capital.

Since the firms are price takers, aggregation of sector production functions is straightforward and, here, has been specified as a CES function type:

$$Y_g = S_g \left[\alpha_{l,g} L_g^{\frac{\theta-1}{\theta}} + \alpha_{r,g} K_g^{\frac{\theta-1}{\theta}} \right]^{\frac{\theta}{\theta-1}} \quad g = 1, \dots, N$$

where Y_g is the level of production, K_g and L_g are respectively the capital and labour demand in the N sectors, θ is the elasticity of substitution, S_g is the scale parameter, which is assumed to be constant over time. In this way, the possibility of technological changes is ruled out.

2.3 The Government.

The Government demands goods, which represent the public consumption, collects taxes and pays subsidies. As we have already said, we impose that the Government balances its budget every year. In this way the annual public consumption of the Government is financed by the generations who live in that period, avoiding in so far the problem concerning the redistribution effects arising from policy changes in overlapping generation models.

In particular, the Government imposes the following domestic tax measures in the model:

- a simple tax on value added (modelled as a proportional tax);
- social charges on the use of primary factors (modelled as a proportional tax on labour demand);
- a corporate tax, featured in the model as a tax on capital services;
- a proportional income tax, whose rate T that is taken to be constant in any given year. The adjustments simply call for replacing the gross return r and w with the net return $r(1-T)$ and $w(1-T)$. That implies that the net marginal interest rate is lower (given r) so there will be a slower rate of consumption growth.

2.4 Equilibrium conditions.

In the general equilibrium solution the behaviour of each sector of the economy is consistent with the present and future prices that clear markets. On the markets for goods, the equilibrium conditions state that demand is equal to supply. Similarly, the labour market is competitive and there are no constraints on behaviour of firms or workers.

Given the perfect foresight hypothesis, the behaviour of the economy today depends on conditions in the future. One cannot compute a "separate" equilibrium for a given year without a complete characterisation of future economic developments. So, the solution method must treat the present and future together. Hence we need to treat the goods produced at different periods of time as goods produced in different markets.

2.5 Model calibration.

The model has been calibrated to equate its benchmark solution for the year 1982 with actual values referred to the Italian economy to generate a steady-state growth model. We assume as a common convention that all the nominal prices are equal to 1.

The growth rate of the economy is determined by a pure population growth effect, which was set to be consistent with the long-run growth of the Italian economy. To calculate it we use the hypothesis that, in steady-state, K/L is constant, therefore:

$$\frac{K_t}{L_t} = \frac{K_{t+1}}{L_{t+1}} = \frac{K_t + I_t}{(1+n)L_t}$$
$$n = \frac{I}{K}$$

where:

n = rate of population growth;

I_t = aggregate investment at time t ;

K_t = capital supply at time t ;

L_t = labour supply at time t .

The remaining parameters have been obtained by the calibration procedure. We had to determine:

- the individual consumption demands differentiated by cohort and by goods;
- the individual capital services supplies differentiated by cohort;
- the pure rate of time preference.

To proceed in calibrating the model we used as parameters the following data:

- the total demand;
- the total saving;
- the rate of interest;
- the population growth.

Sensitivity analysis has been done on the interest rate and on the intertemporal elasticity of substitution. Along with the life-cycle theory, if we reduce the intertemporal elasticity we have to increase the value of the interest rate, otherwise the

pure rate of time preference will tend to zero or to negative values. With an intertemporal elasticity of substitution in the interval $[1, 0.8]$, we can apply an interest rate equal to 5%, then if we want to decrease the elasticity we need to increase the interest rate. The bequests have been calibrated by modifying the consumer intertemporal budget constraint. The hypothesis is that when the consumer is 46 years old he receives a bequest from his parents. Furthermore, we suppose that the consumer will leave, when he dies, the same amount of money as an inheritance to his sons. Since the population grows at a rate equal to n , the budget constraints will change in this way:

$$P_{g2}I_t + P_1D_{1t} = wL(1 - T) \quad t = 1;$$

$$P_{g2}I_t + P_1D_{1t} = [wL + rK_t](1 - T) + BEQP_{g2} \quad t = 26;$$

$$P_{g2}I_t + P_1D_{1t} = [wL + rK_t](1 - T) + BEQP_{g2}(1+n)^{29} \quad t = 27, \dots, 54;$$

When aggregating the bequests they cancel each other out. In fact adding the equations, we obtain:

$$\begin{aligned} & \sum_{t=1}^{55} I_t(1+n)^{55-t}P_t + \sum_{t=1}^{55} D_t(1+n)^{55-t} \\ &= \sum_{t=1}^{55} Lw(1+n)^{55-t} + \sum_{t=1}^{55} K_tr(1+n)^{55-t} \end{aligned}$$

The applied general equilibrium model of the Italian economy has been solved using the GAMS algorithm.

3. The sector-specific incentives to the capital services.

Before describing the simulation results, it is useful to present some general statements about the incentive programme at issue. The first group of policies analysed concerns the rationing of capital subsidies to the firms, through which one can set priorities in various sectors of the economy with respect to their strategic importance in the country's overall industrialization goal. Subsidies affect households by altering both the absolute resources they have at their disposal and the relative prices of consumption in different years; they have both income and substitution effects. As for the taxation case, it is the latter that causes the distortions. In fact, the subsidies or the fiscal exemptions differentiated by sector and/or factor modify the consumption demand and the factor demand. Hence, the final results depend on the interaction between the production and the consumption side.

The effects of capital taxation dates back to the pioneer study by Harberger (1962), who demonstrated, under certain hypothesis, that the tax burden of a sector and factor specific tax is borne almost entirely by the owners of the factor independent of the fact that the factor has been employed in the taxed or untaxed sector. Similar results have been obtained by Shoven and Whalley (1972) and Shoven (1976) who represented the same type of economy by using a computational general equilibrium model. In particular, Shoven extended the methodological approach modelling a highly disaggregated economy¹². The sensitivity analysis showed that the results are strongly conditioned by the factor intensity and by the relative ratio between the output, which are observable data.

But almost by definition, the long-run consequences are the most important ones, and at least implicitly, they are the ones at the centre of the debate on the effects of the incentive policies. Feldstein (1974) and Grieson (1975) highlighted that the assumption of fixed capital stock may be quite misleading. In particular, Feldstein showed that "in the long-run the burden of a general profits tax is more likely to be divided between capital and labour. The most basic conclusion of this study is the importance of considering capital formation in the analysis of tax incidence¹³". The central feature of long-run models is that the capital supply is considered to be endogenous. In this respect, the results depend also on the capability of the taxed factor to shift part of the burden on the untaxed one. As Feldstein assessed, part of the capital income tax burden can be sustained by the labour factor, while for Grieson the shift to a labour income tax can lead to an increase of the capital/labour ratio such that the policy can be considered convenient even for the workers.

Considering the subsidies as negative taxes, we can easily extend these theoretical implications to our analysis, which concerns the effects on the capital accumulation of sector-specific capital subsidies.

Summarizing, on one side there has been the evolution of the studies concerning the long-run effects of taxation while on the other hand computational models have been developed, which allow for a high level of disaggregation and the study of finite variations of taxes. In particular, it became possible to study the capital accumulation and the adjustment process through which the economy is expanding and how fiscal policies affect these processes. So, in this work, we formulated a general equilibrium applied dynamic model, which has been connected to a static one so that we can work with a high level of disaggregation. We are aware of the fact, that the steady state models have their own drawbacks, since they cannot consider the movement of the

12. See also Boadway and Treddenick (1978), who reached the same results within a model applied to the Canadian economy.

13. Feldstein (1974), p.510-511.

economy from one steady state to another. The advantage is that we study a disaggregated economy using a rational expectation approach.

3.1 Output and substitution effect.

In this section we will present the principal effects one can expect in an applied general equilibrium model deriving from a change in relative prices. We have reallocation effects due to changes in prices and due to the inefficiency deriving from the deviation from the contract curve.

Following Mieszkowski's (1967) terminology, we distinguish between the output effect (depending on the intensity of the factors) and the substitution effects. Both of them have consequences on the ratio between the rate of return on capital and the wage rate (r/w).

Let us consider the case of a two-sectors economy. A sector is defined as labour-intensive if the K/L ratio is proportionally lower than in the other sector, so that:

$$\frac{K_1}{L_1} < \frac{K_2}{L_2}$$

Another important parameter, beside the sector capital/labour ratio, is the factor allocation in the economy. Both productive factors are assumed to be free to move from one sector to another. The factor mobility plays an important role for the de facto distribution issues. As a consequence of the factor mobility, we can say that the positive effects of the subsidies or incentives spread over the whole economy. This hypothesis, which has been considered quite unrealistic for short-run models when referred to capital factor, is much more acceptable in a long-run context.

Let us consider the case in which we subsidize the capital income in sector 1 and capital is fixed in the economy (typical assumption of the static models).

A subsidy to the use of a factor of production will cause a decrease in the output price stimulating both the demand and the production. Therefore, there will be a reallocation of the labour and the capital between the two sectors (the latter depends on the substitutability between factors). These are the so called output effects that generate the intersectoral reallocation of factors, depending on whether the factor subsidised is the intensive one. Given that the sector 1 is labour-intensive, we can expect a decrease in the r/w ratio (the return on capital diminishes in respect to the wage rate) and therefore there should be an increase in the K/L ratio employed in the sector. This result depends on the fact that the increased demand of capital in sector 1 could be less than the amount of capital expelled from the capital-intensive sector. In the end, on the capital market there will be an excess supply which needs to be absorbed.

The subsidies to the capital used in sector 1 will violate the efficiency conditions:

$$MRTS_{KL}^1 = \frac{r(1-s_{K1})}{w}; \quad MRTS_{KL}^2 = \frac{r}{w}$$

where MRTS is the marginal rate of technical substitution between labour and capital for sectors 1 and 2 respectively and s_{K1} is the subsidy rate. Given that the capital market is a perfect one, a simple arbitrage operation will equalise the net return on capital in the economy. In other words, the capital owners will have an incentive to reallocate the capital in the sector that gives the highest returns. These are the so-called substitution effects. Clearly, an increase on the return on capital in sector 1 will lead to a reallocation of the capital from sector 2 to sector 1. Hence, there will be an increase in the L_1 / K_1 ratio and decrease in the L_2 / K_2 ratio. Consequently, there will be an increase in the marginal rate of technical substitution in sector 2 and a decrease in sector 1, independent of the factor intensity. This adjustment process will continue until we get to the point in which, in the subsidized sector, the value of the marginal product will equalise the net return on capital.

This implies that the allocation between labour and capital is not on the contract curve. Consequently, we will be producing inefficiency. In conclusion, subsidizing the capital factor in a capital-intensive sector will generate an increase of the return on capital, since the output effect and the substitution effect operate in the same direction. If, on the other hand, we subsidize the capital factor in a labour-intensive sector, the two effects will be opposite and therefore they could cancel each other out and the r/w could remain unchanged. In other words, the labour income will partially benefit from the delivered subsidies.

The key parameters needed to study this kind of capital incentives are:

- 1) the elasticity of substitution of the goods in the consumer demand;
- 2) the difference in the L_1 / K_1 and L_2 / K_2 ratio;
- 3) the share of capital utilised in the production of the subsidized sector;
- 4) the elasticity of substitution between production factors¹⁴.

The hypothesis behind all these statements is that the capital supply in the economy is fixed. What we add to the analysis is the study of the effects of the subsidies in a model in which the capital supply can vary endogenously. In this context, an increase in the r/w ratio (increase of r or decrease of w) determines an increase in the capital

14. The lower the elasticity of substitution is the bigger is the responsiveness of the r/w to changes in the K/L ratio and therefore the higher is the shift of the subsidies to the labour income.

supply that will stop the growth of the return on capital. In practice, the factor's variability tends to reduce the dimensions of the change in the r/w ratio due to a fiscal change.

Given that we work with an overlapping generations model, the variation of the return to capital modifies the saving choice and it can make some generations better off. In particular, having used a multi-period model, a wealth-effect can take place: in other words the interest rate variations modify the present value of the disposable income.

In the case analysed in simulation, the fiscal policies have been financed by the personal income tax, so that the repercussion on the return on capital passes through two different channels: on one side we have a modification of the gross return on capital caused by the introduction of the sector-specific subsidies and, on the other side, there is a modification of the net return on capital due to the variation of the personal income tax rate.

Given the complexity of the model the only feasible way to work within such a type of framework is to calculate the equilibrium computationally.

4. Savings and investment incentives.

The second group of policies analyzed concerns savings/investment subsidies. Typically the debate revolves around the definition of the taxable income and therefore around equity problems. So, generally the main question is concerning the choice between an income tax base and a consumption expenditure base for personal taxation.

Our present concern is instead with some basic issues of principle about the modality of the supply of the incentives. We confine the analysis to the economic considerations which would be relevant in presence of an income tax regime and governmental intervention that does not lead to a structural reform of the tax system as a whole. It is evident that some modifications of the income tax giving tax relief on particular forms of savings introduce clear elements of a consumption expenditure tax into the system¹⁵. That is particularly clear for the indirect incentives. Still we restricted the attention to the comparison of direct versus indirect incentives. In fact, what we intend to analyze are the effects of various alternative policies aimed at sustaining the capital accumulation. The limitation of the scope of our analysis can be justified on the grounds that it is generally more likely to happen in the real world that small modifications of the tax structure occur rather than dramatic ones. In fact, at least in Italy, the trend seems to decrease the value of the deductions from the income

tax base¹⁶ while there is an increase of the funds utilised to subsidies the acquisition of capital goods. One of the reasons that causes this change could be that almost all the EU financial supports are given in form of direct subsidies.

Thus it could be of some interest to study how these small modifications actually change the whole tax system. In this respect we can say that while direct incentives imply a shift to a tax system in which the capital income is taxed by a negative rate, the indirect policies imply a shift towards a labour income tax or a consumption tax.

Another relevant point is the quantitative impact of the policies under investigation on the capital accumulation process, relative to their cost, which has been pointed out in simulation.

4.1 Indirect incentives.

We then proceed by classifying the incentives depending on the modality of the supply. We can talk alternatively about direct and indirect incentives. Indirect incentives operate through the personal income tax while with direct incentives we refer mainly to the subsidies given to the consumers at the moment of the acquisition of capital goods.

We proceed to review various considerations about the indirect incentives and we discuss the problem of the direct subsidies in the next sub-paragraph.

Traditionally investment incentives identify the fiscal policy aimed to promote the capital market demand while savings incentives are aimed at promoting the capital market supply. Within a neoclassical framework, the real policy effects are not concerned with the side of the market which is formally subsidized, but questions arise about the identification of the qualified items to obtain the fiscal deduction. For example Auerbach and Kotlikoff (1987) consider as savings incentives the ones given for the acquisition of new and old capital assets while they consider as investment incentives the ones given just for acquisition of new capital assets. In this case the two policies cannot have the same real effects since they apply to different tax bases. In our analysis we consider the savings incentives, therefore we do not make a distinction between new and old capital but we focus on the different impact of total and partial deductions.

The analysis has been limited to incentives to the acquisition of machinery and/or to their capital services, therefore all the different policies have a positive effect on the growth of the capital accumulation even in presence of a decrease of the interest rate.

16. For example right now one can deduct just the 22% of the fees paid for private contributions from the personal income tax base while last year the fixed percentage was the 27%.

To illustrate the impact of the different policies we consider a simple two-period model in which the consumer is subject to a proportional income tax, works in the first period and retires in the second. We also assume that the consumer can invest any savings which he makes in machinery or some other form of physical investment. Then the consumer will maximise his utility function:

$$U = F(C_1, C_2)$$

under his lifetime budget constraint:

$$C_1 P_1 + C_2 \frac{P_2}{[1 + r_2(1 - T)]} = L w_1(1 - T)$$

where: w_1 is the wage rate, r_2 is the interest rate, L is the fixed labour supply, T is the income tax rate, C_1 is the present consumption, C_2 is the future consumption, price P_1 is the current price of the consumption good and P_2 is the future price. From the first order conditions we obtain the marginal rate of substitution:

$$MRS = \frac{P_1[1 + r_2(1 - T)]}{P_2}$$

Given that the income tax rate is included in the equation, this kind of taxation is not neutral, because it has a substitution effect on the resource allocation.

a) Total deduction.

Let us consider the case in which the taxpayer can deduce from the taxable income all purchases of investment goods. At the same time the sales of investment goods as well as the income yield on capital goods should be added to the tax base¹⁷. Therefore we will have:

$$\begin{aligned} C_1 P_1 + IP_I &= w_1 L - (w_1 L - IP_I)T \\ C_1 P_1 + IP_I(1 - T) &= w_1 L(1 - T) \end{aligned}$$

Given that the allowance is given to new capital as well as old, when the consumer has to sell his capital asset on the market to obtain liquidity, he will get the market price P_I , supposing that the depreciation rate is equal to zero. Then, we will have:

17. These are the so-called savings incentives. See Auerbach and Kotlikoff (1987) p.129

$$IP_1(1+r_2)(1-T) = C_2P_2$$

and the intertemporal budget constraint becomes:

$$C_1P_1 + \frac{C_2P_2}{(1+r_2)} = w_1L(1-T)$$

In other words, this policy is equivalent to a shift from an income to a labour tax at rate T . From the first order conditions we obtain a marginal rate of substitution equal to:

$$T = \frac{t}{(1+t)}$$

These two kinds of taxes are no longer equivalent when the consumer has inherits in the first period or when we consider an overlapping generations model. In the latter case, still considering a two-period model, a young and an old individual coexist in each period. Actually, these two types of taxes are not equivalent for the old individual. In fact, he will not be taxed in presence of a labour income tax. While if one adopts a consumption tax, he will pay it. In the latter case the consumption tax will not have any distortionary effects given that the old individual cannot change his consumption decisions. We can conclude that by taxing labour income one implicitly makes a transfer from young to old generations.

b) Partial deduction.

We turn now to consider a programme of partial deduction of the purchase of capital assets: the tax relief is given just for a percentage of the purchase of capital asset. Supposing that z is the rate of the allowance, the consumer budget constraint will change as follow:

$$\begin{aligned} C_1P_1 + IP_1 &= w_1L - (w_1L - zIP_1)T \\ &= w_1L(1-T) + zTIP_1 \end{aligned}$$

and it implies a subsidized price for the investment good equal to:

$$q = P_1(1 - zT)$$

The return on capital will be calculated on the nominal value of the asset. Still the capital proceeds from the sale would be subject to tax:

$$IP_I(1 - zt) + r_2 IP_I(1 - T) = C_2 P_2$$

Therefore the consumer budget constraint is¹⁸:

$$C_1 P_1 + C_2 \frac{P_2}{\left[1 + \frac{r_2(1-T)}{(1-zT)}\right]} = w_1 L(1 - T)$$

which is equivalent to the budget constraint of the case in which we tax the labour income at a rate equal to T and we tax the capital income at a rate equal to $T(1 - z) / 1 - zT$ ¹⁹. In other words it is a partial relief of the capital income tax. The marginal rate of substitution in this case is equal to:

$$MRS = \frac{[1 + r_2(1 - T)]}{(1 - T)}$$

4.2 Direct incentives.

We now turn to consider the direct incentives. Any income from which the consumers purchase would be subject to tax, the income yield on them would be subject to tax, but the capital proceeds from their sale would not be subject to tax. Formally, we provide a subsidy at the rate T on purchases of investment good:

$$C_1 P_1 + IP_I(1 - T) = w_1 L(1 - T)$$

which is equivalent to a deduction of the amount that has been saved:

18. Let us consider a simplified economy, with no second-hand market and an incentives programme which allows consumers to deduct the purchase of new capital assets from the income tax base. Consumers who want to sell their old capital assets, which have already benefitted from the allowance, could ask a maximum price of the new capital asset minus the subsidy. Otherwise, there would be no market for the old goods. In this way we will get the same budget constraint as in the case of the partial exemption.

19. See Auerbach and Kotlikoff (1987), p.133.

$$C_1 P_1 + IP_I = w_1 L - (w_1 L - IP_I)T$$

Successively the investment goods are resold at the nominal value, given that whoever buys the asset is entitled to apply for the tax relief. Therefore the owner will realize:

$$IP_I(1-T) \frac{[1+r_2(1-T)]}{1-T}$$

Hence we can rewrite the budget constraint as follows:

$$C_1 P_1 + C_2 \frac{[1-T]}{[1+r_2(1-T)]} = w_1 L(1-T)$$

This policy is equivalent to a fiscal structure in which the labour income is taxed at the rate equal to T and a capital income taxed at:

$$-\frac{T}{r_2(1-T)}$$

So the marginal rate of substitution will be:

$$MRS = \frac{P_1[1+r_2(1-T)]}{P_2(1-T)}$$

The same policy could be reviewed considering a rate of the subsidy different from the income tax rate:

$$C_1 P_1 + IP_I(1-zT) = w_1 L(1-T)$$

which is equivalent to a partial deduction of the savings:

$$C_1 P_1 + IP_I = w_1 L - (w_1 L - zIP_I)T$$

The consumer budget constraint will be equal to:

$$C_1 P_1 + C_2 P_2 \frac{(1-zT)}{[1+r_2(1-T)]} = w_1 L(1-T)$$

One of the limits of the two-period model are connected with the impossibility of taking into account the wealth effects due to variations of the interest rate. Furthermore we also find of some interest to give a quantitative appraisal of these types of policies on the capital accumulation process. Therefore we perform the simulation concerning the different incentives using the computational model presented in the first section.

So far we have outlined four different methods of applying savings/investment incentives with a very simple analytical tool to show the main differences in adopting direct or indirect incentives. Of course from a practical point of view there are some aspects which do not apply to particular taxes but of general importance which are worth noting here. Contrarily to the direct incentives, the effectiveness of the indirect incentives by definition depends on the pre-existing fiscal structure. Supposing that the incentive mechanism operates through the personal income tax, they will favour high-income taxpayers. Even regardless of questions of equality, this way of proceeding does not allow to value critically the different investment projects. In other words, these kinds of incentives promote the saving without considering the efficiency of the different ways in which one can use money. Another relevant difference for the economic agents is the moment of fruition of the different types of incentives. The direct incentives, in fact, are contextual at the moment in which the agent buys a capital asset. Sometimes the application to obtain the subsidy is submitted before the project is already started. On the other hand, the indirect incentives take place at the moment in which one should pay the income tax.

5. Results of the simulations.

This section describes a variety of counterfactual simulations. As we already said, the aim of the simulations is to study the effects of sector-specific capital subsidies on the capital stock accumulation process and therefore on saving given that the capital supply is variable. The Government covers the new expenses by increasing the personal income tax. Therefore, in the simulation, the personal income tax rate varies endogenously so that the public expenditure will be kept constant in real terms.

More precisely, we impose a strong concept of equal yield in that the Government collects the same revenue to sustain the same real consumption every year.

In interpreting the results, we should consider two factors:

1) a change in the taxation will implicitly cause an intergenerational redistribution. The welfare effects on the steady-state are the result of the intrinsic efficiency of a certain tax and of the implicit redistribution. The separation of the two effects requires the determination of the transition path to the new steady-state in such a way so as to

allow for the welfare effects caused by the redistribution within the intermediate generations²⁰,

2) the presence of proportional intergenerational transfers implies a strong sensitivity of the savings to the interest rate, independent of the value of the intertemporal elasticity of substitution.

The simulations have been done in a version of the model in which there are just two productive sectors: namely the agricultural sector (sector 1) and the industry and services sector (sector 2). The structure of the model is already implemented to be used in a disaggregated version²¹. Either the investment good and the public expenditure good are produced by sector 2. We choose as the numeraire the price of the good produced by sector 2.

From an aggregate point of view, the agricultural sector represents the 9,39% of the GDP. The capital employed by that sector is the 4,5% of the total capital supply in the benchmark situation. The labour demand represents the 11% of the fixed endowments. As far as the intensity of factors is concerned sector 1 has a K/L ratio lower than the one of sector 2, therefore sector 1 is labour-intensive.

The benchmark data are summarised in table 2 for the economy and in table 3 for the single sectors (the data are in billions liras)²²

20. The efficiency effects of a certain fiscal reform in a dynamic model also depends on other factors, such as the schedule of the reform, the expectations of the economic agents and the public debt policy during the transition period.

21. To work within a more disaggregated version we just need to prepare an appropriate data set.

22. The data come from an aggregation of the data used for the ITALIA/GE model

TABLE 2
Benchmark Data Set

OVERALL ECONOMY - 1982	
Saving	75530.08
Total demand	592038.79
Total capital supply	4584256.53
Total labour supply	478819.04
Investment	708031.87
ratio K/L	9.57

TABLE 3
Benchmark Data for Sector 1 and Sector 2

	SECTOR 1	SECTOR 2
Price	1	1
L/K	0.2739	0.0965
Capital demand	205278.83	4378977.7
Labour demand	56231.14	422587.9
Level of production	66495.08	641536.79

The principal parameters exogenously fixed are reported in Table 4.

TABLE 4
Principal Model Parameters

Rate of population growth	N	0.0018
Elasticity of substitution between K and L	θ	0.9
Interest rate	r	0.05
Intertemporal Elasticity of Substitution	σ	0.9
Intratemporal Elasticity of Substitution	γ	0.75
Pure rate of time preference	ρ	0.0063

5.1 Subsidy to the agricultural sector.

We subsidized the capital services in the agricultural sector, namely sector 1, at 5%. We also perform the sensitivity analysis on i) the elasticity of substitution between capital and labour, ii) the intratemporal elasticity between consumption goods, iii) the rates of the subsidy, as specified in Table 5.

TABLE 5
Sensitivity Analysis

	θ	γ
case (a)	0.9	0,75
case (b)	0.9	0,1
case (c)	0	0,75
case (d)	0	0,1

where θ is the elasticity of substitution between K and L , and γ is the intratemporal elasticity of substitution in the consumer utility function. The results obtained in simulation have been summarised in Table 6.

Since sector 1 is labour-intensive we can expect that the output effects and the substitution effects will work in opposite directions on factors prices. Let us consider the case (1a) in which the elasticity of substitution between K and L , is equal to 0,9 and the intratemporal elasticity of substitution in the consumer utility function is equal to 0,75. First we notice a decrease of the relative price of the agricultural good so that, given the hypothesis of a certain level of substitutability between goods, an increase of the demand for the good produced by the subsidized sector occurs and consequently we have an increase in the production of that sector and a decrease in the production of sector 2. Due to a quite high value of the elasticity of substitution between factors, the positive output effect on the price and on the labour factor is more than compensated by the substitution effect, which promotes the use of technologies that use a relatively higher share of the subsidized factor. Therefore we have a reduction in the demand for labour and an increase in demand for capital: capital tends to substitute labour, diminishing the L/K ratio in sector 1, mitigating the intensity of the use of the labour factor. Given that the labour supply in the economy is fixed, the part that has been expelled from sector 1 should be consumed by sector 2. To make such an increase in labour demand possible, there has been quite a significant decrease in the wage rate, given that the level of production has decreased.

Nonetheless there is a positive substitution effect in favour of the capital in the subsidized sector, since the latter represents a very small percentage of the GDP, the decrease of the capital demand in sector 2 is higher than the increase in sector 1. In the end, aggregating, a decrease of the capital demand takes place and leads to a negative effect on the capital accumulation.

The discounted wage rate is diminished and therefore also the present value of the consumer income is decreased. Given the reduction of the rate of return on capital and therefore of the discounted price of the goods, the consumers augment the income share retained for saving, denoting also an implicit redistribution from the young people to the old people. On average, anyway, the negative effect on income prevails, so finally we have a savings decrease. Therefore, also the K/L ratio of the steady-state will decrease in respect to the K/L ratio of the benchmark.

In case (1b), in which the elasticity of substitution between K and L , is equal to 0,9 but the intratemporal elasticity of substitution in the consumer utility function is equal to 0,1, we obtained almost the same results. Given the lower substitutability between goods, the levels of production, cannot change significantly.

Let us consider the case (1c), in which the production functions are modelled as fixed coefficients (Leontief) and the intratemporal elasticity of substitution in the consumer utility function is equal to 0,75. The substitution effects cannot take place, so we force the factor demand to move in the same direction as the level of production. Due to the

price reduction we have an increase in the final demand, in the production function and hence in the factor demand. The results in sector 2 are symmetric to that obtained in sector 1: a relative increase of the price of the good causes a decrease of the demand and of the production. The rate of return on capital and the wage rate are subject to less strong variation. Even here, the increase of the capital demand in the subsidized sector is not enough to compensate the decrease that took place in the other sector. Consequently, there is a smaller capital accumulation than in the benchmark. On the consumer side, the decrease of the discounted present value of income and of the discounted prices leads to a shift of the consumer choices towards saving. Even in this case, the income reduction is such that aggregating there is a decrease in savings, in aggregate consumption and in total quantity produced in the system.

Let us now discuss the case (1d), which differs from the previous one because we impose a very low intratemporal elasticity of substitution (0,1). The reduction of the price of the agricultural goods as well as the increase of the production level are far less significant than in the previous cases. The K/L ratio is slightly decreased, given that the saving and the capital supply are decreased.

In conclusion, the subsidies have not been self-financing and lead to a less efficient resource allocation, in fact the equivalent variations are negative. As I already pointed out, I preferred to stress the effects on the capital accumulation because the equivalent variations can suffer from the absence of the transition path.

Subsidising the capital factor in the labour-intensive sector leads to a reduction of the price of the good produced, therefore to an increase in demand and in the level of production. Symmetrically, in the other sector there is always a decrease in the level of production. There is always an increase in the capital demand in the subsidised sector (even if it is labour-intensive) and a decrease in sector 2.

In cases (1a) and (1b) the substitutability between factors induces a reduction of the labour demand in sector 1 and an increase in sector 2.

In cases (1c) and (1d) the factor demands vary in the same direction of the level of production. This causes an increase of the factor's demand in sector 1 and a decrease in sector 2. Consequently, in both cases the reduction of the wage rate allows an increase of the labour demand in presence of a reduction of the production level; in the other case, the reduction of the wage rate is related to the fact that quantitatively the decrease of the labour demand in sector 2 is anyway superior to the increase in sector 1.

On the other hand, an increase in the rate of return on capital, a decrease in capital accumulation and in savings always occurs. The r/w ratio increases and therefore K/L ratio decreases. This process causes a reduction in the discounted value of income deriving from a reduction in the wage rate and a decrease in purchasing power.

According to Table 6, Y_i is the level of production in sector i ; K_i and L_i are the demand for capital and labour respectively; P_i is the price of good i ; r is the net of taxes rate of

return of capital and w is the net of taxes wage rate; K is the total supply of capital, S is the saving; the EV are the equivalent variations. The values are the percentage variations of the variable in respect to the benchmark equilibrium, apart from the EV which are a percentage change in respect to the total amount given as subsidy.

TABLE 6
Subsidy to Sector 1 at 5% Rate

	case (1a)	case (1b)	case (1c)	case (1d)
Y_1	0.55237	0.06907	0.53842	0.07254
Y_2	-0.0753	-0.0161	-0.0717	-0.0097
K_1	4.32891	3.80732	0.53888	0.07273
K_2	-0.2409	-0.2005	-0.0717	-0.0097
L_1	-0.1204	-0.5983	0.53875	0.07353
L_2	0.01603	0.00188	-0.0717	-0.0978
P_1	-0,84	-0,84	-0,82	-0,83
r	0,19	0,21	0,17	0,21
w	-0,1	-0,11	-0,09	-0,11
K	-0.0363	-0.0211	-0.0444	-0.006
S	-0.0365	-0.0213	-0.0441	-0.0061
EV	-4.9149	-4.8683	-4.59	-48.207

5.2 Subsidy to the industrial sector.

A subsidy on capital services in sector 2 is introduced at the rate of 5% on the price paid by entrepreneurs. As before the sensitivity analysis has been performed on the elasticity of substitution among K and L in the production function and on the intratemporal elasticity. The results obtained in simulation are summarised in Table 7.

The overall effect of the subsidy, which is the sum of the output effect and of the substitution effect, is likely to reduce the price of good 2. Then the production level, demand for capital and labour will augment. Because of the subsidy and, partially,

because the sector 2 is capital-intensive, the demand for input shifts towards the use of capital services and the return on capital rises to reduce the corresponding excess of demand. Of course, this result implies that the factors of production are substitutes.

Let us consider the case (2a) in which the elasticity of substitution between K and L , is equal to 0,9 and the intratemporal elasticity of substitution in the consumer utility function is equal to 0,75. The price of good 2 decreases and demand and production grows. The K/L share and the relative price of capital services rise, due to the augmented demand of capital input in the subsidized sector. Since the production of sector 2 corresponds to a large quota of GDP, the sectoral reallocation of capital determines an higher rate r/w , in spite of the diminished demand of capital services in sector 1. Since the after tax wage declines while the net interest rate rises, the general effect is a reduction of the discounted value of the consumers' income. Because of the changes in relative prices, however, the purchasing power of income rises and both consumption and saving augment.

The qualitative results do not change when produced goods are poor substitutes (for lower values of the intratemporal elasticity) but the quantitative impact of price and quantity variations is quite mitigated.

If there is no possibility of changing the composition of capital and labour inputs in both productions (case 2c and 2d), demand for both capital and labour services augment in the subsidized sector and diminish in sector 1. The effect upon saving and capital accumulation is positive, despite the decrease in the net interest rate. Turning to the consumption side, the net wage rises while the net price of capital declines. The general effect is to reduce the discounted value of the consumers' income. Equivalent variations are positive in both the cases.

TABLE 7
Subsidy to Sector 2 at 5% Rate

	case (2a)	case (2b)	case (2c)	case (2d)
Y_1	-0.3259	0.38037	-1.1802	-0.1606
Y_2	0.72133	0.64024	0.15695	0.02134
K_1	-2.3988	-1.6754	-1.1809	-0.1605
K_2	2.1452	2.08877	3.35184	0.02136
L_1	0.58137	0.76186	-1.1806	-0.161
L_2	-0.0077	-0.1014	0.1571	0.02142
P_1	1.24	1.25	1.84	1.87
r	3.6	3.6	1.35	1.24
w	0.81	0.83	1.93	1.98
K	1.94173	1.92021	0.09721	0.01321
S	1.94128	1.91949	0.09698	0.01383
EV	-13.076	-12.707	9.65008	10.4442

All the simulations have been conducted for different values of the subsidy rate (from 1% to 50%): the changes in the economic variables maintain the same direction. The only difference is that, clearly, for higher subsidy rates the quantitative variations are much more significant than the one in Table 6 and Table 7, which refer to the case in which the subsidies rates is 5%. I emphasised these set of values because the rate is quite similar to the effective corporate tax rate.

5.3 Indirect and direct incentives.

The policies that has been analyzed in simulation are:

D) Indirect Incentives:

- total deduction: consumer can deduce from the income tax base the total purchase of capital asset. These assets plus the accumulated interest will be taxed when withdrawn.

- partial deduction: consumers can deduct only 50% of the purchasing price of capital assets from their income base.

II) Direct incentives in the form of a subsidy on the purchasing of a capital asset, which correspond to a combination of labour income tax and a subsidization to the capital income tax. The rate of the subsidy has been fixed at a rate equal to the income tax rate T and successively at a 50% of T .

We reiterate that it is the personal income tax rate being simulated and which varies endogenously to keep the public expenditure constant in real terms.

TABLE 8

	INDIRECT INCENTIVES		DIRECT INCENTIVES	
	Total deduction	Partial Deduction	Subsidy rate= T	Subsidy rate= zT
K accumulation	+10,9%	+5%	+11%	+5%
Savings	+51%	+23%	+64%	+29%
Production	+3,4%	+1,6%	+3,5%	+1,5%
w	+3%	+1,5%	+2%	+1%
r	-7,8%	-3,8%	-9%	-4%
EV	+9%	+9,5%	+7,9%	+8,8%

In all the simulations performed the results are pretty similar in qualitative terms, but they are quite different from a quantitative point of view. They are summarised in Table 8. As we can see from this table an increase in the capital accumulation of about 10% for the total deduction and total subsidy cases always occurs. Within the others two policies we obtained an increase of 5%.

The savings generally show substantial variations. In analyzing these results one should be aware that the intertemporal elasticity of substitution is quite high. Specifically, the savings increases by 64% when the subsidy rate is equal to T , 51% in the case of the total deduction. Corresponding to an increase in savings we have a decrease in total final demand. There is always an increase in the industry production sector which has to satisfy the increased demand for capital goods. The gross as well as the net interest rate decreases. Typically one should expect that a decrease in the interest rate leads to a decrease in savings, but in this case the savings have been stimulated by the decrease in the price of capital goods. Therefore there is an increase in the savings and the supply of the capital services on the market which lead to a decrease in the interest rate. We also get an increase in the wage rate.

The equivalent variations, always positive, are slightly higher for the indirect incentives.

Summarising: we get an increase in capital accumulation and in savings. Even if the total final demand decreases there is an increase in the production level of the industry sector due to the increased demand for capital goods. We also get an increase in the wage rate and a decrease in the interest rate. Typically a decrease in the interest rate should lead to a decrease in savings. But in this case the savings has been stimulated by a decrease in the price of capital goods: the increase of the savings and the capital services supply lead to a decrease in the interest rate.

6. Conclusions.

Without attempting to be exhaustive, the results of the simulations presented in this article contribute to make clear some interesting points. First, for a long-run analysis of fiscal policies it became necessary to use a computational model even if not applied to a real economy. In particular, it becomes possible to analyse the same phenomenon in a quite complex economy with a variable capital supply. We can expect that the factor variability will reduce the dimensions of the change in the ratio of the capital return and the wage rate.

As far as the sector-specific capital subsidies are concerned, contrarily to what one can think, they can lead to negative effects on the growth of the economy. The dynamics generated shows that Government interventions can produce results that do not necessarily go in the desired direction. These negative effects have been caused by a combination of an excessive penalisation of the labour factor and a loss of the purchasing power of the consumers. The latter strictly depends on the initial consumption combinations.

Helping productive sectors, which constitute a relatively low share of the consumer bundles, can lead to an increase in the prices of the goods produced by other sectors, determining a loss in the purchasing power.

More specifically, by subsidising the capital services in the labour-intensive sector, we find an increase in the capital return, a decrease in saving and therefore also in the capital accumulation. We always had a decrease in the present value of the income determined by a decrease in the discounted wage rate. The results maintained the same direction even when the elasticity of substitution between factors and the value of the subsidy were altered.

Instead, by subsidising to the capital-intensive sector, the return on capital, the capital accumulation and the saving increase. The results are sensitive to the elasticity of substitution between factors of production. Using a Leontief function, we have, after tax, a decrease in the rate of return on capital and an increase in the wage rate, thus inducing an increase in the discounted present value of income. The equivalent variations are positive only in this case. The suggestion is not that some combination of increased direct taxes and subsidy to capital factor is undesirable, but rather that it may not be always the most suitable policy to be adopted to stimulate the capital accumulation process.

The second group of simulations focuses on the different modality of supplying the incentives to investment. We confine the analysis to economic considerations concerning government interventions which does not lead to a structural reform of the tax system as a whole. In particular we analysed the difference in using direct versus indirect incentives. Of course, even smaller modifications change the tax system to some extent. In fact, starting from an income tax base, direct incentives imply a shift towards a tax system in which the capital income is taxed by a negative rate while indirect incentives imply a shift toward a labour income tax or a consumption one.

Accordingly to what one can intuitively expect, all the different policies that subsidise the purchaser of the new or old asset produce a positive effect on the growth of the economy, even in presence of a decrease in the interest rate. The quantitative impact of these policies on the process of capital accumulation is substantial, despite the fact that they can be considered a minor modification of the existing tax structure.

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